CRUSTAL DEFORMATION MODELS OF THE SOUTHERN SAN ANDREAS FAULT SYSTEM FROM CONTINUOUS AND FIELD GPS DATA

FINAL TECHNICAL REPORT

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Abstract

The Pacific-North American (P-NA) plate boundary in northern Baja California, Mexico and southernmost California, is characterized by a complex transition from ocean spreading in the Gulf of California to right-lateral, strike slip faulting along the San Andreas fault (Elders *et al.*, 1972, Figure 1). The Salton Trough, immediately north of the Gulf, has low elevations, thin crust and high heat flow, and is thought to be a zone of incipient ocean spreading (Lomnitz *et al.*, 1970, Lachenbruch *et al.*, 1985, Larsen and Reilinger, 1991). This section of the P-NA plate boundary is historically among the most seismically active for moderate sized earthquakes. Paleoseismic and geodetic studies indicate a major slip deficit on the southernmost San Andreas fault which will likely give rise to a significant earthquake in the future (Sieh and Williams, 1990, Bennett *et al.*, 1996).

Since 1986, a consortium of universities and government agencies has been using the Global Positioning System (GPS) to monitor crustal deformation along the southernmost San Andreas fault system (e.g., Reilinger and Larsen, 1993; Bennett *et al.*, 1996). The observation network presently extends from the San Bernardino Mountains to the Gulf of California (Figure 2).

Bennett *et al.* (1996) used GPS data for the period 1986–1995 and a simple elastic block model to constrain fault slip rates on the various faults comprising the plate boundary in this area. In the present study, we update the velocity field by including earlier VLBI data and 1997 GPS observations, and we use the model of Bennett *et al.* (1996) to better constrain fault slip rates, and we investigate the tectonic implications of residual velocities not accounted for by the block model.

Data Analysis

The data set for our analysis includes essentially all of the VLBI and high-precision GPS measurements acquired in southern California between 1980 and 1997, listed in detail with the description of Version 2 of the SCEC velocity field (http://www.scecdc.scec.org/group_e/release.v2). The analysis was performed in two steps: The VLBI group delay or GPS phase observations from each day were first used to estimate station coordinates, which were then used as quasi-observations to estimate station velocities over several years (Feigl *et al.*, 1993; Dong *et al.*, 1998). For stations within 500 km of the 1992 Landers earthquake or 150 km of the 1994 Northridge earthquake, we estimated coseismic displacements but constrained the velocities before and after the earthquakes to be equal. Our estimated velocities for the southern San Andreas region, shown with 95% confidence ellipses in Figure 2, agree within their uncertainties with those in the SCEC velocity field. The two analyses used the same quasi-observations, generated variously by analysts at MIT, Scripps, and UCLA, but differ in data weighting, realization of the reference frame, and constraints applied to co-seismic displacements.